

2.7 Lines

A. Introduction

Project plans use lines with a variety of weights, styles and patterns to graphically provide the information needed to bid and construct a project. The Caltrans CADD system has various features with different symbology to easily distinguish them on a plan sheet, and standardizes symbology for consistency.

Standard Specifications Section 5-1.02, Contract Components states that written numbers and notes on a drawing govern over graphics. So even though symbology is used to represent various features, a label or callout takes precedence over symbology.

B. Line Weight

Line quality is critical for readability of 11" x 17" project plans. Line weight (width) is varied to distinguish classes of features. The more basic outlining features are emphasized with heavier (wider) lines (e.g., alignment lines, construction layout lines and basic outline of objects).






Medium-weight lines are used for proposed construction and Right of Way. Light-weight lines are used for existing topography, dimensions and other less important details.

Weight	Feature	Appearance
1	Object Lines	Dark and sharp
0	Dimension Lines	Sharp, thin lines
0	Object Center Lines	Sharp, thin lines
1	Hidden Lines	Dark and sharp
0	Station Callout Lines	Sharp thin lines
1	Right of Way	Dark and sharp
4	Sheet Border	Heavy and dark
3*	Alignment lines for Main route(s)	Dark and bold
2*	Alignment Lines for Ramps and Local Streets	Dark and bold
1	Stations for all Alignment Lines	Dark and sharp

- * Using varying line weights makes the main route alignment appear more prominently than secondary alignment lines, which in turn, appear more prominently than proposed construction lines (e.g., edge of pavement, edge of shoulder, median barriers, etc). If the weight of an alignment line obscures or interferes with proposed

construction lines, the weight of the alignment line may be reduced to provide greater clarity of the work to be performed.

Line Weight Examples









WEIGHT	APPEARENCE (LINE CODE 0)	DESCRIPTION
0		Dimension lines, object centerlines and station callout lines. Interior horizontal lines (for rows) within a quantity table.
1		Edge of pavement, shoulders and gutters; obliteration; resurfacing; P.I. tangent lines and interior vertical lines (for columns) within a quantity table. Various data including drainage facilities, object lines, various details, and right of way lines.
2		Alignment Lines for ramps and local streets. Exterior borders for quantity tables and profile grade line.
3		Alignment line for main route(s)
4		Sheet border

Line Weights for Structures Design are defined in a table in each Structures Design seed file.

C. Line Codes

Line codes (particularly the solid line, LC = 0) depict a recognizable symbology used for the majority of features shown on project plans. Line codes should not be confused with line styles.

There are eight (8) standard line codes built into MicroStation that include one solid line and seven various dashed lines. The seven dashed lines are symbolic; they look the same when plotted regardless of the plot scale and on the monitor regardless of the view zoom.

Line Code	Sample	Definition
0		Solid or continuous line. Use for proposed design elements, objects (not hidden) and dimension lines.
1		Dotted line - sometimes used for existing features.
2		Short dashed line – sometimes used for existing features.
3		Long dashed line - used for depicting hidden details & existing non-structural features. Also used to show fill (toe of slope).
4		Dash dot
5		Medium dashed line - used to show cut (top of cut).
6		Dash-dot-dot – used to show existing structural features.
7		Long dash-short dash – used to show object centerlines.

D. Dashed Lines

Dashed lines are used to represent existing information as well as to graphically distinguish one item of work from another. Dashed lines may represent a variety of miscellaneous uses like easements, environmentally sensitive areas or various boundary lines. Dashed lines may be line codes, line styles or linear patterns. When a dashed line is used, it must be labeled for the specific use or bid item it represents.

E. Line Styles

1. Overview

Line styles depict Caltrans standard line symbology. Line styles are scalable and allow an element to retain its geometry. The Caltrans Standard Plans include standard line symbology for design features, water pollution control, utilities, topographic mapping and other features. The Caltrans standard line style resource file is "ctlstyle-SS3.rsc." All Caltrans line styles are shown in Appendix A4.

Line styles are not part of the design file, unlike linear patterning which uses cells. The Caltrans line style resource file must be present on the workstation and MicroStation must be configured to use it.

2. Line Style Scale Factor

The size of all graphics for all line styles in Caltrans line style resource files (i.e., ctlstyle.rsc, and Ct_Topo_1style.rsc) are based on the metric scale 1:500, therefore, a scale factor must be applied when placing any line style. The scale factor varies depending on the intended plot scale. The intended plot scale must be expressed as a ratio before computing the line style scale factor. For example, a plot scale of 1"=50' expressed to a ratio is:

$$\frac{1''}{50'} \times \frac{1'}{12''} = 600, \text{ or } 1:600$$

The formula for line style scale factor is:

$$\text{line style scale factor} = \frac{\text{intended plot scale ratio}}{\text{resource file scale ratio}} \times \text{metric conversion factor}$$

The left number of the ratio is always 1 and is not used in the computation. The resource file scale ratio is 1:500. The metric conversion factor is 3937/1200. Therefore the line style scale factor for 1"=50' plot scale is:

$$\text{line style scale factor} = \frac{600}{500} \times \frac{3937}{1200} = 3.937$$

Line Style Scale Factors for Caltrans Standard Plot Scales

Caltrans Standard Plot Scale	Standard Plot Scale Ratio	Line Style Scale Factor
1"=20'	1:240	1.5748
1"=50'	1:600	3.937
1"=100'	1:1200	7.874

If there is a need to use a metric plot scale, the metric conversion factor is 1 for computing the line style scale factor used to place a line style.

F. Line Symbolology for Utilities

This section applies to project plans and utility verification maps.

In the Caltrans standard level convention for pre-version 8 (pre-V8) format design files, existing utilities go on level 5 (level 5 is dropped out when plotted) and proposed utilities go on level 40 (see Appendix A8). Existing utilities plotted as dropped out were not always sufficiently legible on project plans, inducing some users to move existing utilities to a non-dropout level. Subsequently, separate line styles were made to depict existing and proposed utilities. The line styles for existing utilities have lowercase letters and those for proposed utilities have uppercase letters.

To further differentiate existing and proposed utilities, use weight 1 for existing and weight 3 for proposed. On a utility plan that is busy and crowded with information, or on another project plan (other than a utility sheet) that also shows utilities for the convenience of the contractor and resident engineer, it is an option to adjust the line weight to 0 for existing and 2 for proposed.

Examples of Utility Symbolologies

—— -E—— —— -E—	Underground electric line (Proposed)
—— -e—— —— -e—	Underground electric line (Existing)
—— -E—— —— {OH}	Overhead electric line (Proposed)
—— -e—— —— {oh}	Overhead electric line (Existing)

In version 8 (V8) format design files, there is a dedicated level for each Caltrans line style representing a specific type of utility (in both the standard numbered level and named level conventions) to accommodate the district utility database. For more information on the standard level conventions for utilities, see Section 2.4 and Appendices A9 and A10. All of the utility levels (whether existing, abandoned or proposed) are non-dropout levels. If the decision is made to show existing utilities as dropped

out, change the color to obtain the dropped out plotting effect (see Chapters 2.8 C and 5.10). Do not move any utility to another level (such as an undefined dropout level) to obtain the dropped out plotting effect because this will hinder the ability to use the utility database.

If, in the future, utility verification maps are plotted in color for utility companies, the line styles depicting utilities were created to default to various colors. The cell “aautil” in the Caltrans standard cell libraries (CTCELLIB.cel and CTCELLIB_NamedLevels) shows the established colors. The color yellow is not used because it is not legible when plotted. The Caltrans standard color table “ctcolor.tbl” must be used for correct color values to be displayed.

Color Number	Color Value	Utility Type
0	White (plots black)	Joint (Overhead or Trench)
1	Blue	Water
2	Green	Gas
3	Red	Electrical
5	Purple	Telecommunications
6	Orange	Sewer
7	Brown	Oil